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THE RELATION OF
SPEED, RANGE AND LEVEL
TO SCORES ON
INTELLIGENCE TESTS

By JOHN R. CLARK

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CONTENTS

	PAGE
The Problem.....	1
Relation Between Speed and Intelligence.....	1
Relation Between Level and Intelligence.....	10
Relation Between Information and Intelligence.....	20
Relation Between General Range and Intelligence.....	24
Relation Between Combined Scores of Intelligence Tests and Combined Level Scores.....	30
Intelligence and Arithmetic Speed, Range and Level.....	30
Intelligence and Completion Speed, Range and Level.....	31
Generalized Relationships.....	34
Appendix	36

THE RELATION OF SPEED, RANGE AND LEVEL TO SCORES ON INTELLIGENCE TESTS

THE PROBLEM

Psychologists in general believe that modern intelligence tests measure native intellectual capacity. Many educators, however, believe that scores on intelligence tests are determined less by native intellectual power than by other factors such as richness of extra-school environment, the individual's speed of reaction, and the quality of the school training. Particular objection has been made against the time or speed element in the tests. The problem of this investigation is to analyze these complex instruments by determining their relationships with three relatively clearly defined functions.

Thorndike has suggested that one's score on a standard instrument for measuring intelligence is in a degree determined by one's *speed* of reacting, one's *range of information*, and one's general *power* or *level*. Let us call these aspects of, or qualities of, or dimensions of, intelligence. The specific problem of this investigation is to determine the amount of the association between each of these qualities and the scores made by 180 pupils (grades VII-XII) on the Otis Self Administering Group Test, and the Terman Group Test, and the Stanford Revision of the Binet Test.

I. THE RELATIONSHIP BETWEEN SPEED AND INTELLIGENCE

Two measures of speed. The two measures of speed used in this study were: (1) the speed at which pupils solved arithmetical problems and (2) the speed at which they "completed" sentences.

SPEED IN SOLVING ARITHMETICAL PROBLEMS

Each of the 180 pupils was tested individually on the *I. E. R. Arithmetical Problems, Test A1, B1, C1, and C2*. Stop watch records of the time spent by each pupil on each test element in this series of tests constitute the data for speed on Arithmetical Problems. Samples of the tests are reproduced here.

SAMPLES OF THE I. E. R. ARITHMETICAL PROBLEMS

- AAA (7) How many inches are there in 2 feet and 7 inches? Answer—
 AA (7) What is the cost of 300 things at 50 cents a hundred? Answer—
 A1 (7) What number subtracted from 47 leaves 39? Answer—
 B1 (7) How many pencils can you buy for 50 cents at the rate of 2 for 5 cents? Answer—
 C1 (7) I bought $4\frac{1}{2}$ yards of cloth, gave the clerk \$2 and received 20 cents as correct change. What was the price of the cloth per yard? Answer—
 C2 (7) If a train travels half a mile in a minute what is its rate per hour? Answer—

In securing a measure of the speed at which pupils solve these examples, it seemed desirable not to include test elements on which there was a large number of incorrect answers. We prefer to have a measure of the speed at which pupils do these tasks correctly. Therefore, after scoring the test elements it was necessary to omit Test *C1* and *C2* because of the large number of incorrect responses. In general, pupils who did less than 80% of the elements of Test A1 and Test B1 were excluded from the study.* Originally records were secured on 192 pupils, but owing to the decision to exclude cases in which the accuracy was less than 80%, the number of cases was reduced to 180.

Reliability of Scores on Speed in Arithmetic. In order to obtain a measure of the reliability of the scores on speed in

CORRELATION TABLE 1
Series I (Median No. of Seconds)

		0	2	4	6	8	10	12	14	16	18	20
		1	3	5	7	9	11	13	15	17	19	21
<i>Series I (Median No. Seconds)</i>	30-31	--	--	--	--	1	--	--	1	--	--	--
	28-29	--	--	--	--	--	--	--	--	1	--	1
	26-27	--	--	--	1	--	--	--	--	--	--	--
	24-25	--	--	--	--	--	--	--	1	1	--	--
	22-23	--	--	--	--	1	1	2	--	1	--	--
	20-21	--	--	--	1	--	1	2	1	--	--	--
	18-19	--	--	--	2	3	1	3	2	1	1	--
	16-17	--	--	1	1	3	5	3	--	--	--	--
	14-15	--	--	--	2	4	7	3	1	1	1	--
	12-13	--	--	--	4	11	6	4	1	--	--	--
	10-11	--	--	1	14	16	5	--	--	--	--	--
	8-9	--	--	7	20	8	1	--	--	--	--	--
	6-7	--	--	7	6	1	--	--	--	--	--	--
	4-5	--	--	3	--	--	--	--	--	--	--	--
	2-3	--	--	--	--	--	--	--	--	--	--	--
	0-1	--	--	--	--	--	--	--	--	--	--	--

*There were 9 exceptions; no case was retained if the percentage of incorrect answers exceeded 40.

arithmetical problems, the median number of seconds spent on the elements of Test A1 (Series I) was correlated with the median number of seconds spent on the elements of Test B1 (Series II). The tabulated results of the scores on Series I and Series II are given in *Correlation Table 1*.

The raw reliability correlation coefficient* between Series I and Series II is .66, while the corrected** coefficient is .79.

Correlations between speed in arithmetical problems and the mental ages as measured by the Stanford Revision of the Binet Test. Series I and II (arithmetical speed) were combined, and the reciprocals*** of the results correlated with the mental ages as determined by the Stanford Revision of the Binet Test. The tabulated results are shown in *Correlation Table 2*.

CORRELATION TABLE 2
Arithmetical Speed—Series I-II

	4 5	6 7	8 9	10 11	12 13	14 15	16 17	18 19	20 21	22 23	24 25
Mental Age—Binet											
280-9	--	--	--	--	--	--	1	--	--	--	--
270-9	--	--	--	1	--	--	--	--	--	--	--
260-9	--	--	--	--	1	--	--	--	--	--	--
250-9	--	--	--	--	--	1	--	--	1	--	--
240-9	--	--	3	2	4	1	--	1	--	--	--
230-9	--	2	1	2	--	3	--	--	--	--	--
220-9	--	--	3	--	4	3	--	--	1	--	1
210-9	1	2	2	7	4	4	1	2	--	--	--
200-9	--	7	10	3	6	1	--	1	--	--	--
190-9	--	4	10	6	7	3	--	--	--	--	--
180-9	1	9	10	2	3	--	--	--	--	--	--
170-9	3	5	4	5	1	--	1	--	--	--	--
160-9	2	6	6	2	--	--	--	--	--	--	--
150-9	--	--	--	--	--	--	--	--	--	--	--
140-9	1	1	--	--	--	--	--	--	--	--	--

The raw correlation coefficient between speed on arithmetical problems and mental age on the Stanford-Binet Test is .50; the corrected coefficient is .55. It thus appears that speed in solving the arithmetical problems in Test A1 and Test B1 is *positively* and *significantly* associated with mental age as measured by the Stanford-Binet Test.

*Pearson Product Moment.

**Corrected by the Spearman-Brown formula: $r_x + = \frac{nr}{(n-1)r+1}$

***The scores in each case are 100 times the reciprocal of each combined score.

The relation between speed in arithmetical problems and scores on the Terman Group Intelligence Test. Scores of Arithmetical Speed, Series I-II, were correlated with the scores on the Terman Group Intelligence Test. The tabulated results are shown in *Correlation Table 3*.

CORRELATION TABLE 3

Arithmetical Speed

	0	2	4	6	8	10	12	14	16	18	20	22	24
	1	3	5	7	9	11	13	15	17	19	21	23	25
<i>Terman Group</i>													
210-9	--	--	--	--	--	--	2	--	--	1	--	--	--
200-9	--	--	--	--	--	--	3	2	2	1	2	--	1
190-9	--	--	--	--	2	2	2	4	--	--	--	--	--
180-9	--	--	--	1	1	6	3	6	--	1	--	--	--
170-9	--	--	--	1	5	4	7	2	1	--	--	--	--
160-9	--	--	--	2	8	4	4	1	--	--	--	--	--
150-9	--	--	1	--	2	1	2	1	--	1	--	--	--
140-9	--	--	1	3	8	3	2	--	--	--	--	--	--
130-9	--	--	1	5	5	4	1	--	--	--	--	--	--
120-9	--	1	--	4	7	--	1	--	--	--	--	--	--
110-9	--	--	1	4	4	1	1	--	--	--	--	--	--
100-9	--	--	--	3	1	2	2	--	--	--	--	--	--
90-9	--	--	2	3	3	1	--	--	--	--	--	--	--
80-9	--	1	--	--	1	1	--	--	--	--	--	--	--
70-9	--	--	1	--	--	1	--	--	--	--	--	--	--
60-9	--	--	1	1	1	--	--	--	--	--	--	--	--

The raw correlation coefficient between speed on arithmetical problems and scores on the Terman Group Test is .60; the corrected coefficient is .67. Thus speed, as it appears in the solution of arithmetical problems, is more closely associated with scores on the Terman Group Test than with the Stanford-Binet mental ages.

The relation between speed on arithmetical problems and scores on the Otis Self Administering Group Intelligence Test. Arithmetical Speed, Series I-II, was correlated with the scores on the Otis S. A. Test. The tabulated results are shown in *Correlation Table 4*.

The raw correlation coefficient between speed on arithmetical problems and scores on the Otis S. A. Test is .63; the corrected coefficient is .71. Speed, therefore, as it appears in the solution of arithmetical problems is more closely associated with the scores in the Otis S. A. Test than with the scores on either of the other two intelligence tests.

CORRELATION TABLE 4

Arithmetical Speed

	0	2	4	6	8	10	12	14	16	18	20	22	24
	1	3	5	7	9	11	13	15	17	19	21	23	25
<i>Scores on Otis S. A.</i>													
85-88	--	--	--	--	--	--	--	--	--	--	--	--	--
81-84	--	--	--	--	--	--	--	--	--	--	--	--	--
77-80	--	--	--	--	--	--	--	--	--	--	--	--	--
73-76	--	--	--	--	--	--	--	--	--	--	--	--	--
69-72	--	--	--	--	--	--	2	1	2	1	1	--	1
65-68	--	--	--	--	--	2	2	6	--	1	1	--	--
61-64	--	--	--	--	3	1	3	6	--	--	--	--	--
57-60	--	--	--	2	2	6	9	1	--	1	--	--	--
53-56	--	--	--	4	5	7	4	1	--	1	--	--	--
49-52	--	--	--	6	7	3	5	--	1	--	--	--	--
45-48	--	--	3	7	8	6	--	1	--	--	--	--	--
41-44	--	1	--	7	11	1	2	--	--	--	--	--	--
37-40	--	1	3	3	5	3	1	--	--	--	--	--	--
33-36	--	--	1	5	4	1	2	--	--	--	--	--	--
29-32	--	--	--	1	2	--	--	--	--	--	--	--	--
25-28	--	--	--	--	1	--	--	--	--	--	--	--	--
21-24	--	--	1	1	--	--	--	--	--	--	--	--	--

SPEED IN COMPLETING SENTENCES

Test Material Used. Each of the 180 pupils was tested individually on the *I. E. R. Completion Tests AAA, AA, A1, B1 and B2*. Stop watch records of the time spent by each pupil on each test element in this series of tests constitute the data for speed on Completion Sentences. Samples of the tests are reproduced here.

SAMPLES OF I. E. R. COMPLETION TESTS

AAA (7) Two and three make———

AA (7) Water is —— to drink.

A1 (7) He went carefully over the road from——end to the——

B1 (7) The dog——a useful——because——his intelligence and faithfulness.

B2 (7) No——what happens wrong is——right.

Reliability of scores on Speed in Completing Sentences. To secure a measure of the reliability of the scores on speed in completing sentences, the median number of seconds spent on the odd numbered elements, called Series I, in Tests AAA and AA was correlated with the time spent on the even numbered elements in these tests, Series II. The tabulated results of the scores in Series I and Series II are shown in *Correlation Table 5*.

CORRELATION TABLE 5

Completion Speed I

		2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	8
		2.49	2.99	3.49	3.99	4.49	4.99	5.49	5.99	6.49	6.99	8.49
<i>Completion Speed II</i>	7.5-7.99	--	--	--	--	--	--	--	--	--	--	1
	7 -7.49	--	--	--	--	--	--	--	--	--	--	1
	6.5-6.99	--	--	--	--	--	--	--	--	--	--	--
	6 -6.49	--	--	--	--	1	--	2	--	1	--	--
	5.5-5.99	--	--	--	--	1	1	--	--	--	--	--
	5 -5.49	--	--	1	--	12	6	7	2	1	1	--
	4.5-4.99	--	--	--	--	--	--	--	--	--	--	--
	4 -4.49	--	--	7	9	26	5	10	--	--	--	--
	3.5-3.99	--	--	--	--	--	--	--	--	--	--	--
	3 3.49	4	4	41	7	15	--	2	--	--	--	--
	2.5-2.99	--	--	1	--	--	--	--	--	--	--	--
	2 -2.49	9	2	1	--	--	--	--	--	--	--	--

The raw reliability correlation coefficient between *Series I* and *Series II* (speed in completing sentences) is .78; the corrected coefficient is .88.

The correlation between speed in completing sentences and mental age (Stanford-Binet). Correlation Table 6 shows the relation between Completion Speed (Series I-II) and Mental Age (Stanford-Binet).

CORRELATION TABLE 6

Completion Speed

		12	15	18	21	24	27	30	32	36	39	42	45	48
		14	17	20	23	26	29	32	34	38	41	44	47	50
<i>Binet</i>	280-9	--	--	--	--	--	--	--	--	--	--	--	--	1
	270-9	--	--	--	--	--	--	--	--	--	--	--	1	--
	260-9	--	--	--	--	--	--	1	--	--	--	--	--	--
	250-9	--	--	--	--	--	--	1	--	1	--	--	--	--
	240-9	--	--	--	1	--	2	1	3	1	--	--	--	3
	230-9	1	--	--	--	2	1	--	4	--	--	--	--	--
	220-9	--	--	--	--	3	1	1	4	1	--	1	1	--
	210-9	--	--	--	1	1	10	--	8	1	1	--	--	1
	200-9	--	--	3	9	4	2	--	7	--	1	--	--	2
	190-9	--	1	3	6	5	2	2	7	1	1	2	--	--
	180-9	--	--	4	5	6	4	1	3	1	--	--	--	1
	170-9	2	--	2	3	6	1	1	3	1	--	--	--	1
	160-9	1	1	3	5	2	2	--	2	--	--	--	--	--
	150-9	--	--	--	--	--	--	--	--	--	--	--	--	--
	140-9	--	--	--	2	--	--	--	--	--	--	--	--	--

The raw correlation coefficient is .42; the corrected coefficient is .49, slightly lower than the correlation between speed on arithmetical problems and mental age as determined by the Stanford-Binet.

The correlation between speed in completing sentences and scores on the Terman Group Test. Correlation Table 7 shows the relation between Completion Speed, Series I-II, and Terman Group.

CORRELATION TABLE 7

Completion Speed

[illegible]

The raw correlation coefficient is .28; the corrected coefficient is .32. Thus, the speed at which 180 pupils complete the sentences in Test AAA and AA is less closely associated with their scores on the Terman Group Test than with their mental age scores on the Stanford-Binet.

CORRELATION TABLE 8

(Completion Speed)

[illegible]

Correlation between speed in completing sentences and scores on the Otis S. A. Test. Correlation Table 8 suggests the relation between Completion Speed, Series I-II, and Otis S. A. scores.

The raw correlation coefficient is .43; the corrected coefficient is .49. There is the same degree of association between Completion Speed and Otis S. A. as there is between Completion Speed and Stanford-Binet.

Is speed in solving arithmetical problems closely associated with speed in completing sentences? We have secured highly reliable measures of the speed at which 180 pupils solve arithmetical problems and the speed at which they complete sentences. The data are based upon the speed at which pupils respond with an accuracy of 80% or greater, except in 9 instances. If the speed at which people react to the tasks to which they can react correctly or nearly so, is a fairly *constant* factor or trait, the correlation between speed on Arithmetical Problems and speed on Completion Sentences should be high. Correlation Table 9 suggests the relation between them.

CORRELATION TABLE 9
(Completion Speed)

	12 14	15 17	18 20	21 23	24 26	27 29	30 32	33 35	36 38	39 41	42 44	45 47	48 50
<i>Arithmetical Speed</i>													
24-25	--	--	--	--	--	--	--	1	--	--	--	--	--
22-23	--	--	--	--	--	--	--	--	--	--	--	--	--
20-21	--	--	--	--	--	--	--	--	2	--	--	--	--
18-19	--	--	--	--	--	--	1	2	--	--	--	--	1
16-17	--	--	--	--	--	--	--	1	--	--	--	--	2
14-15	--	--	--	--	1	4	1	6	--	--	1	1	2
12-13	--	--	2	5	7	3	1	6	2	1	2	--	1
10-11	--	--	4	6	3	5	--	9	--	1	--	1	1
8- 9	--	1	4	10	8	7	5	10	3	--	--	--	--
6- 7	3	--	3	8	8	5	--	6	--	1	--	--	2
4- 5	1	1	1	3	1	1	--	--	--	--	--	--	--
2- 3	--	--	1	--	1	--	--	--	--	--	--	--	--

The correlation between completion speed (I-II) and arithmetical speed (I-II) is .42; the corrected coefficient is .50. It thus appears that arithmetical speed correlates with completion speed less closely than it correlates with either of the three intelligence test scores. It would have been desirable to determine the correlation between speed in handwriting, speed in

adding single columnus, and the like, with the scores on the intelligence tests. On the basis of our limited data, however, we question the following hypothesis of Downey:*

“One’s speed of movement is obviously a matter of considerable practical importance, since it determines the amount of physical work that one can put through in a given time. In trade-tests and in vocational tests in general, speed has been recognized as a factor in accomplishment on a level with the factor of accuracy.”

“In another connection the author has shown that graphic speed is, in fact, symptomatic of general bodily speed of movement. It has, furthermore, been found to correlate with speed in other specific activities (rapidity of tapping or articulation, for example); and it correlates, as will be shown later, with all the other items in the speed group, which can only be interpreted as meaning that it has general characterial significance.”

Summary. We have found the following amounts of correlation between speed and intelligence scores:

r _{ar.} speed and Binet M. A.	==.55
r _{co.} speed and Binet M. A.	==.49
Mean	==.52
r _{ar.} speed and Otis S.A.	==.71
r _{co.} speed and Otis S.A.	==.49
Mean	==.60
r _{ar.} speed and Terman group	==.67
r _{co.} speed and Terman group	==.32
Mean	==.495

*The Will-Temperament and Its Testing, page 86f.

II. THE RELATIONSHIP BETWEEN LEVEL AND INTELLIGENCE

Meaning of "Level." We are investigating the relation of *speed, level, and range of information*, to scores made on three standard intelligence tests. By *level* we mean the ability to do difficult tasks in solving arithmetical problems, and the ability to complete sentences of increasing difficulty. *Level* then may be thought of as synonymous with *power* or *difficulty*.

Test materials for measuring level. Two groups of tests were used to secure measures of level, the *I. E. R. Arithmetical Problems Tests* and the *I. E. R. Completion Tests*. The Arithmetical Problems Tests contained test elements, ranging in difficulty from very easy problems to very difficult problems. Samples of the test elements are reproduced here.

SAMPLES OF I. E. R. ARITHMETICAL PROBLEMS

D1 (7) $15 = \dots \times 4$. Answer——

D2 (7) $11 = \dots \times 3$. Answer——

E1 (7) In 1913, a certain family of 4 persons spent \$12 per month per person for food and \$28 per month for the whole family for rent. What did they spend for food and rent for the whole year. Answer——

E2 (7) $18 = \dots\%$ of 40.

F1 (7) Four men buy a hundred shares of stock for \$4,000. Brown pays \$1,600. Jones pays \$1,200, Smith pays \$800, and Thompson pays \$400. How many shares should each have? Answer——

F2 (7) How much must a road rise in each 100 feet of length if it rises 60 feet in 2,000 feet of length? Answer——

G1 (7) On June 22 the sun rises at 4:30 and sets at 7:30. What per cent of the 24 hours is daylight? Answer——

H1 (7) How much of each of P, N, and K would you buy to make a ton containing P, N, and K in the proportions 9, 8, and 3, respectively? Answer——

It is helpful to think of these tests as constituting a ladder. A pupil's score is determined by the height or level to which he can climb on this ladder of difficulty.

Administration of tests. These tests were given as group tests. Pupils were allowed as much time as they needed to go

as far through the test series as their power permitted. In general 2 class periods provided sufficient time for pupils to reach their limit.

Derivation of Measures of Level in Arithmetic. The elements in these tests were grouped into a series of "levels"; the differences between the levels being about equal. This work was done in the Institute of Educational Research, and will be reported in another investigation.

The arithmetic levels, together with the elements comprising them, as determined by the Institute of Educational Research, are:

Level 20	{ Series I—A11, A17, B15, B11, B12, B17, C12, C13, C24, D21. Series II—A12, A19, A14, B16, B14, B18, C18, C21, C27, D23.
Level 30	{ Series I—A13, C22, C23, E16, B13, C11, C19, D13, D15, E23. Series II—A16, B19, C14, C16, C26, C25, D17, D26, D28, D210.
Level 40	{ Series I—B110, C110, C210, D11, D12, E19, E21, E25, C29. Series II—C14, C17, C28, D14, D16, D19, D18, E110, E28, E29.
Level 50	{ Series I—D22, D24, D25, E15, E17, F17, F110, F27, F210, G14. Series II—D27, D29, E11, E27, E210, F18, F23, F24, F26.
Level 60	{ Series I—D110, E12, F19, F12, F13, F28, F25. Series II—E24, E26, E14, E18, F14, F22, F29.
Level 70	{ Series I—F11, F15, F21, G11, G15, G17, G18, G21, G23, G24. Series II—F16, G12, G19, G110, G27, G28, G29, G210, G25, G22.

The percentage of correct responses to the elements in each level was then computed. For example, one pupil was scored as follows:

Level 20, 90 % ; Level 30, 70 % ; Level 40, 50 % ; Level 50, 20 % ; Level 60, 0 % ; and Level 70, 0 %.

The determination of level scores. Should a pupil's level score be the point up to which he does practically all of the examples correctly? Or should it be the point up to which he does, say, 50% of the tasks? The number of pupils who passed the lowest level with 100% mastery was so small, that it would have been impossible to derive a score for level if we had insisted upon 100% mastery (correctness). Consequently, we arbitrarily selected the level up to and on which the pupils did 50% of the elements. In a later paragraph there is a note on the correlation between level scores on an 80% mastery and level scores on a 50% mastery.

Rules for Determining Level Scores. The following rules were used to determine level scores:

1. If a pupil scores 50% on some particular level, and has a higher score on all the preceding levels and a lower score on all of the succeeding levels, his score is the number of that level.

Unfortunately for the convenience of scoring, this rule applied very infrequently.

2. When rule 1 does not apply, and when the sum of the successive scores is between 75 and 125, the mean of this sum is added to the lowest score that exceeded 50%.

3. If a pupil scores less than 50% on some particular level, and higher than 50% on two succeeding levels, he is not penalized for that particular low score, the assumption being that it does not really measure his power.

Reliability of Measures of Arithmetic Level. As was suggested earlier, two measures of Arithmetic Level, Series I and Series II, were secured. The amount of correlation between the two series is suggested by Correlation Table 10.

CORRELATION TABLE 10

(Arithmetical Level I)

	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33
<i>Arithmetic II</i>	32-33	--	--	--	--	--	--	--	--	--	--	--	--	1	2	11
	30-31	--	--	--	--	--	--	--	--	1	--	1	--	--	--	2
	28-29	--	--	--	--	--	--	--	--	--	--	1	1	6	4	3
	26-27	--	--	--	--	--	--	1	1	--	2	1	6	4	2	3
	24-25	--	--	--	--	--	--	1	1	--	1	2	3	3	1	2
	22-23	--	--	--	--	--	1	2	2	--	--	2	3	2	--	2
	20-21	--	--	--	1	--	1	6	--	1	--	1	1	1	--	2
	18-19	--	--	--	--	1	2	3	--	1	1	--	2	--	--	1
	16-17	--	--	--	--	--	2	7	2	3	1	3	3	3	--	1
	14-15	--	--	--	1	--	1	2	3	--	2	1	1	--	--	--
	12-13	--	--	--	--	1	1	--	--	--	--	--	--	--	1	--
	10-11	--	1	--	--	1	1	1	3	--	1	1	--	--	--	--
	8-9	--	1	--	--	1	1	1	3	--	1	1	--	--	--	--
	6-7	--	--	--	--	1	3	2	--	--	1	1	--	--	--	--
	4-5	1	2	--	--	--	--	3	--	--	--	--	--	--	--	--
	2-3	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--
	0-1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--

The raw reliability coefficient between Series I and Series II is .77; the corrected coefficient is .87.

Correlation between Level in Arithmetic and Stanford-Binet Mental Age.

Is level or power in solving arithmetical problems closely associated with scores on the Stanford-Binet Test? The relationship between them is suggested by Correlation Table 11.

CORRELATION TABLE 11

Arithmetical Level I-II

[illegible]

The Pearson coefficient of correlation between level in arithmetic and Stanford-Binet is $+ .57$; the corrected coefficient is $+ .65$. This relationship is on the whole closer than that existing between achievement in school subjects and Stanford-Binet scores. It is, as would be expected, higher than the correlation between speed in arithmetic and Stanford-Binet ($+ .55$).

Correlation between Level in Arithmetic and Scores on the Terman Group Intelligence Test. The correlation between level

CORRELATION TABLE 12

Arithmetical Level I-II

[illegible]

in arithmetic and the Terman Group Test (see Correlation Table 12) is considerably higher than that found with the Stanford-Binet. The raw coefficient is .74; the corrected coefficient is + .80. This is highest correlation thus far obtained.

Correlation between Level in Arithmetic and Scores on the Otis S. A. Test. The amount of the correlation between Level in Arithmetic and Otis S. A. scores is suggested by Correlation Table 13.

CORRELATION TABLE 13

Arithmetic Level I-II

	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32
	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33
<i>Scores on Otis S. A.</i>																
69-72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	7
65-68	--	--	--	--	--	--	--	--	--	--	1	--	1	4	3	3
61-64	--	--	--	--	--	--	--	--	1	1	--	--	6	2	3	--
57-60	--	--	--	--	--	--	--	1	--	2	3	4	5	3	2	1
53-56	--	--	--	--	1	3	1	1	--	2	1	3	5	5	--	--
49-52	--	--	--	--	1	1	--	4	2	3	3	4	3	1	--	--
45-48	--	--	1	--	--	--	3	7	5	4	1	2	1	--	1	--
41-44	1	1	--	--	2	2	3	5	5	--	1	1	--	1	--	--
37-40	--	2	1	1	2	1	2	2	--	3	--	1	--	1	--	--
33-36	--	--	--	5	1	3	1	1	1	1	--	--	--	--	--	--
29-32	--	--	--	1	1	--	1	--	--	--	--	--	--	--	--	--
25-28	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
21-24	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

The raw Pearson coefficient of correlation is + .74; the corrected coefficient is + .83.

It thus appears that the two groups tests, Terman and Otis, are considerably more closely associated with level in arithmetic than is the Stanford-Binet.

Each of these tests correlates higher with Level in Arithmetic than with Speed in arithmetic. This fact suggests that intelligence tests measure something that is more closely related to the type of mental activity involved in problem-solving than to the more habitual or more automatic kinds of responses. In fact there is a prevailing impression that intelligence tests measure primarily that type of mental activity which we call power, or ability to meet novel situations. Later sections of this study bear upon this issue.

Before proceeding to a consideration of Level in Completion Sentences, it is interesting to note that the correlations between

level in arithmetic and each of the group tests is nearly as high as the correlation between the group tests themselves.

Correlation between Ar. Level and Terman--	.80
Correlation between Ar. Level and Otis-----	.83
Correlation between Otis and Terman-----	.88

Obviously the *I. E. R. Arithmetical Problems Test* would be about as reliable an instrument for sectioning or classifying pupils as is either of the two intelligence group tests. If the correlations were equally high, the intelligence tests would be preferable, because of the great difference in the time required to administer them.

The fact that these correlations between Level in arithmetic and intelligence test scores are so much higher than those usually found between Arithmetical Reasoning Tests and Intelligence Tests may be accounted for by the fact that the *I. E. R. Arithmetical Problems Tests* are unusually long, about two class periods being required to take them.

THE COMPLETION LEVELS

Measures of Completion Level. Measures of level or power to complete sentences were secured by using the *I. E. R. Completion Tests*, samples of which are reproduced below. These tests were given in the same manner as were the *Arithmetical Problems Tests*.

SAMPLES OF THE I. E. R. COMPLETION TESTS

- D1 (7) It may-----effort and a long-----but the result is sure.
- E1 (7) -----is natural that being dissatisfied with the-----, we should form a too-----estimate of the past.
- E2 (7) Enthusiasm sometimes might-----the Puritans to pursue unwise-----, but-----to choose-----means.
- E3 (7) This magazine is the-----of a new and progressive movement.
- F1 (7) Stupid-----will usually-whatever-----are-----but the kind of difficulties felt by-----and thoughtful children-----instructive.
- F2 (7) The words 'slave' and 'right' are----- . They mutually exclude each other.
- F3 (7) Undue consciousness often-the flow of expression-----diffuseness is detrimental to a clear and-----exposition of our ideas.
- G1 (7) The human race may be-----as parcelled-into a-----of distinct groups-----societies, -----greatly in size and circumstances.
- G2 (7) India is rich in-----of scenery and climate, -----the -----mountains to vast-----deltas raised-----a few -----above sea-----.

- G3 (7) Farmers brought up in the tradition of the———of New England, on going where close association and co-operation were———to carry on irrigated agriculture, found that it took a long———and involved———waste to learn———to act———
- H1 (7) Life is———short———run———possibilities; we———have———.
- H2 (7) The most abiding———free government is to get large assemblies to work promptly and smoothly———legislative or executive purposes.

Derivation of Measures of Level in Completion Sentences.
The elements in these tests were grouped into a series of "levels," the differences between the levels being about equal. This work was made available to the writer by the Institute of Educational Research. The Completion Levels, together with the elements comprising them, are:

- Level 30 } Series I—AAA7, A13, A16, AA7.
 } Series II—AAA10, A110, A12, AA8, AA16.
- Level 40 } Series I—A17, A11, B13, B17, B111, B24, B29.
 } Series II—A15, B16, B15, B18, B21, B28, B210.
- Level 50 } Series I—D16, B23, B14, E110, E21, D110, E21, A19, E26, B26, B11.
 } Series II—A16, E33, B110, E23, D17, B19, E37, E34, B27, B12.
- Level 60 } Series I—B112, E28, D14, E19, D13, D15, D12, E24, D18, G27.
 } Series II—E31, D11, E28, E15, E25, E11, D19, E29, G21.
- Level 70 } Series I—E18, E17, E22, F24 F31, F39.
 } Series II—F26, F14, E13, E16, F28, G210.

This series of Completion Levels constitutes a ladder or difficulty test. Each pupil was urged to climb as high on the ladder as he could. About two class periods were required by the pupils.

TABLE 14
Scores on Completion Level I

		14	16	18	20	22	24	26	28	30	32	34
		15	17	19	21	23	25	27	29	31	33	35
<i>Scores on Completion Level II</i>	34-35	--	--	--	--	--	--	1	--	--	2	2
	32-33	--	--	--	--	--	--	1	1	2	2	1
	30-31	--	--	--	--	--	--	1	1	--	1	--
	28-29	--	--	--	--	1	--	5	2	2	4	1
	26-27	--	1	--	--	5	2	3	2	3	4	--
	24-25	--	--	--	1	5	6	3	1	--	2	--
	22-23	--	1	--	5	10	8	6	4	--	1	--
	20-21	1	2	2	13	8	3	3	--	--	--	--
	18-19	1	1	1	4	10	--	1	1	--	--	--
	16-17	--	2	1	9	5	--	1	--	--	--	--
	14-16	--	--	3	--	1	--	--	--	--	--	--
	12-13	--	1	--	1	--	--	--	1	--	--	--

Determination of Scores of Level in Completion Sentences. The same procedure that was used in the Arithmetic Levels was used here.

Reliability of measures of Completion Level. The reliability correlation coefficient between Series I and Series II was $+.69$; the corrected coefficient was $+.82$.

Correlation between Completion Levels I-II and Stanford-Binet Scores. As in the case of the Arithmetic Level and the Stanford-Binet, again here the correlation between Completion

TABLE 15
Completion Level I-II

	12 13	14 15	16 17	18 19	20 21	22 23	24 25	26 27	28 29	30 31	32 33	34 35
<i>Binet</i>												
290-9	--	--	--	--	--	--	--	--	--	--	--	--
280-9	--	--	--	--	--	--	--	--	--	--	1	--
270-9	--	--	--	--	--	--	--	--	--	1	--	--
260-9	--	--	--	--	--	--	--	--	1	--	--	--
250-9	--	--	--	--	--	--	--	--	--	--	2	--
240-9	--	--	--	--	--	--	2	1	5	2	1	--
230-9	--	--	--	1	--	1	1	--	2	3	--	--
220-9	--	--	--	--	--	2	2	2	2	3	--	1
210-9	--	--	--	3	4	4	6	5	1	--	--	--
200-9	--	--	3	8	8	5	3	1	--	--	--	--
190-9	--	1	3	11	5	8	1	--	--	--	--	1
180-9	1	3	5	10	4	2	--	--	--	--	--	--
170-9	--	2	8	4	3	2	--	--	--	--	1	--
160-9	--	3	3	5	4	1	--	--	--	--	--	--
150-9	--	--	--	--	--	--	--	--	--	--	--	--
140-9	--	--	1	1	--	--	--	--	--	--	--	--

Level I-II and Stanford-Binet is $+.65$ (raw .57). The writer was of the opinion that the abilities involved in completing sentences were more directly associated with the abilities measured by intelligence tests than were the abilities involved in solving arithmetical problems.

Correlation between Completion Levels and Terman Group Scores. The coefficient of correlation between scores on completion Levels I-II and Terman Group scores is $+.59$; the corrected coefficient is $+.66$. The Terman Group test and the Stanford-Binet are influenced about equally by the abilities involved in completing sentences.

TABLE 16
Completion Level (Composite)

	14	16	18	20	22	24	26	28	30	32	34
	15	17	19	21	23	25	27	29	31	33	35
<i>Terman Group</i>											
210-9	--	--	--	--	--	2	--	--	1	--	--
200-9	--	--	--	--	--	1	1	4	1	3	1
190-9	--	--	--	--	--	1	1	4	3	1	--
180-9	--	--	--	3	2	3	5	4	1	--	--
170-9	--	--	1	1	1	6	3	3	3	1	1
160-9	--	1	1	5	3	5	2	1	1	--	--
150-9	--	--	2	2	6	--	1	--	--	--	--
140-9	--	--	4	8	11	--	--	--	--	--	--
130-9	--	--	1	8	4	3	--	--	--	--	--
120-9	--	2	2	3	2	4	--	--	--	--	--
110-9	--	2	3	4	--	2	--	--	--	--	--
100-9	--	1	5	2	--	--	--	--	--	--	--
90-9	1	2	2	3	1	--	--	--	--	--	--
80-9	--	--	2	--	1	--	--	--	--	--	--
70-9	--	1	--	1	--	--	--	--	--	--	--
60-9	--	--	1	2	--	--	--	--	--	--	--

Correlation between Completion Levels I-II and Otis S. A. Test.

The raw coefficient of correlation between Completion Level (I-II) and Otis S. A. is $+.55$; corrected for attenuation,

TABLE 17
Completion Level (Composite)

	14	16	18	20	22	24	26	28	30	32	34
	15	17	19	21	23	25	27	29	31	33	35
<i>Otis S. A.</i>											
73-76	--	--	--	--	--	--	--	--	--	--	--
69-72	--	--	--	--	--	--	1	1	3	2	1
65-68	--	--	--	1	2	4	2	1	1	1	--
61-64	--	--	--	1	--	5	2	5	--	--	--
57-60	--	--	1	1	3	1	3	7	3	1	1
53-56	--	--	2	7	4	4	2	1	2	--	--
49-52	--	1	3	7	5	4	--	1	--	1	--
45-48	--	1	4	5	7	4	5	--	1	--	--
41-44	1	1	1	10	4	5	--	--	--	--	--
37-40	--	3	4	3	6	--	--	--	--	--	--
33-36	--	3	7	3	--	--	--	--	--	--	--
29-32	--	--	--	3	--	--	--	--	--	--	--
25-28	--	--	1	--	--	--	--	--	--	--	--
21-24	--	--	1	1	--	--	--	--	--	--	--

$r = +.61$. This result agrees very closely with the other results. With the two group intelligence tests, the correlations between Completion Level and Intelligence Scores are considerably lower than were found in the case of Arithmetic Level.

Summary. The following correlations between Level and Intelligence Scores have been secured.

$r_{\text{ar. level and Binet}}$	$= .65$
$r_{\text{ar. level and Terman}}$	$= .80$
$r_{\text{ar. level and Otis}}$	$= .83$
$r_{\text{co. level and Binet}}$	$= .65$
$r_{\text{co. level and Terman}}$	$= .66$
$r_{\text{co. level and Otis}}$	$= .61$

III. THE RELATIONSHIP BETWEEN INFORMATION AND INTELLIGENCE

The third phase of our problem is to determine to what extent general information correlates with each of the three intelligence test scores.

Measures of Information. To secure measures of information for each of the 180 pupils, the I. E. R. Information Tests were employed. Samples of these tests are reproduced here.

SAMPLES OF I. E. R. INFORMATION TESTS

- | | | | | | | |
|----|-----|---|-------------|---------------|-------------|---------------|
| A1 | (7) | The kidneys are in the | head | chest | neck | abdomen. |
| B1 | (7) | The airplane was invented in | Italy | United States | Spain | Austria. |
| C1 | (7) | Hydrogen tastes | sweet | sour | bitter | tasteless. |
| D1 | (1) | The Ayrshire is a kind of | fowl | fruit | cattle | fish. |
| D2 | (7) | The numbers of cylinders in the | Cadillac is | four | six | eight twelve. |
| E1 | (7) | From Paris to Berlin is about | 400 miles | 700 miles | 1,000 miles | 1,300 miles. |
| E2 | (7) | Queen Elizabeth of England was born about | 1425 | 1525 | 1625 | 1725. |
| F1 | (7) | The number of a crab's legs is | four | six | eight | ten. |
| G | (7) | The color of bromine vapor is | violet | green | brown | white. |

TABLE 18
Information Series I

[illegible]

As with speed and level, in order that the reliability of the measures of information might be known, two series of measures were obtained. Series I was the sum of the correct responses to Tests A1, C1, D2 and F1. Series II was the sum of the correct responses to Tests B1, D1, E1 and E2.

Reliability of Measures of Information. The raw r between Series I and II is .69; the corrected r is .82. Correlation Table 18 suggests the correlation.

Correlation between Information Scores and Stanford-Binet Mental Ages. The coefficient of correlation between Information I-II and Stanford-Binet Mental Age for the 180 pupils (see Table 19) was found to be +.58; the corrected coefficient is +.71. Thus Stanford-Binet correlates slightly higher with Information than with either of the measures of Speed or either of the measures of Level.

TABLE 19
Information I-II

	10	12	14	16	18	20	22	24	26	28	30	32	34
	11	13	15	17	19	21	23	25	27	29	31	33	35
280-9	--	--	--	--	--	--	--	--	--	--	--	1	--
270-9	--	--	--	--	--	--	--	--	--	1	--	--	--
260-9	--	--	--	--	--	--	--	--	--	--	--	--	1
250-9	--	--	--	--	--	--	--	--	--	--	1	--	1
240-9	--	--	--	--	--	--	--	--	1	1	5	1	3
230-9	--	--	--	--	--	--	--	2	2	2	--	2	--
220-9	--	--	--	--	--	--	1	2	3	4	--	2	--
210-9	--	--	--	--	1	2	2	2	4	6	4	2	--
200-9	--	--	--	1	3	3	6	5	3	4	2	1	--
190-9	--	--	--	--	1	3	5	3	6	7	5	--	--
180-9	--	1	3	--	1	3	5	4	3	3	1	--	--
170-9	--	1	--	--	4	3	2	7	--	3	--	--	--
160-9	1	1	--	1	4	1	3	3	--	1	1	--	--
150-9	--	--	--	--	--	--	--	--	--	--	--	--	--
140-9	--	1	--	--	1	--	--	--	--	--	--	--	--

Correlation between Information Scores and the Terman Group Scores. The coefficient of correlation between Information I-II and Terman Group Scores (see Table 20).

is +.69; corrected for attenuation, the coefficient correlation is +.74. The correlation between Arithmetic Level I-II and Terman is .80. Between Completion Level I-II and Terman $r = .66$. The mean of these correlations is .73, practically the same as the correlation between Information I-II and Terman.

TABLE 20
Information I-II

	11	13	15	17	19	21	23	25	27	29	31	33	35
	10	12	14	15	18	20	22	24	26	28	30	32	34
<i>Terman Group Scores</i>													
210-9	--	--	--	--	--	--	--	--	--	--	--	1	2
200-9	--	--	--	--	--	--	--	2	--	--	4	3	2
190-9	--	--	--	--	--	--	--	--	2	2	2	3	1
180-9	--	--	--	--	--	--	--	1	2	13	1	1	--
170-9	--	--	--	--	2	--	1	3	6	5	3	--	--
160-9	--	--	--	--	--	2	4	4	2	4	3	--	--
150-9	--	--	--	--	1	1	1	2	2	2	2	--	--
140-9	--	--	--	1	--	5	4	4	4	2	2	1	--
130-9	--	--	--	--	2	1	3	4	1	4	1	--	--
120-9	--	--	1	--	2	2	6	2	--	--	--	--	--
110-9	--	--	1	--	1	3	4	1	2	--	--	--	--
100-9	--	1	--	--	--	1	1	4	--	--	--	--	--
90-9	1	1	1	--	5	--	--	--	1	--	--	--	--
80-9	--	--	--	1	1	--	1	--	--	--	--	--	--
70-9	--	--	--	--	--	--	--	1	--	--	1	--	--
60-9	--	2	--	--	1	--	--	--	--	--	--	--	--

Correlation between Information Scores and Otis S. A. Scores.

The coefficient of correlation between Information I-II and Otis S. A. Scores (see Table 21) is + .66; corrected for attenuation,

TABLE 21.
Information I-II

	11	13	15	17	19	21	23	25	27	29	31	33	35
	10	12	14	16	18	20	22	24	26	28	30	32	34
<i>Otis S. A.</i>													
69-72	--	--	--	--	--	--	--	1	--	1	2	4	1
65-68	--	--	--	--	--	--	--	1	2	5	2	--	1
61-64	--	--	--	--	--	--	--	2	3	2	2	3	1
57-60	--	--	--	--	2	--	1	3	4	7	3	2	2
53-56	--	--	--	--	--	2	4	1	3	8	3	--	--
49-52	--	--	1	1	1	2	5	3	4	4	--	--	--
45-48	--	--	--	--	1	5	3	5	3	4	4	--	--
41-44	--	--	1	--	3	2	7	5	1	--	2	--	--
37-40	1	1	--	1	4	3	2	2	1	1	--	--	--
33-36	--	1	1	--	1	1	3	4	1	--	1	--	--
29-32	--	1	--	--	1	--	--	1	--	--	--	--	--
25-28	--	--	--	--	1	--	--	--	--	--	--	--	--
21-24	--	1	--	--	1	--	--	--	--	--	--	--	--

$r = + .71$. We recall that the correlation between Arithmetic Level and Otis is .83; between Completion Level and Otis, $r = .61$. The mean of these two correlations is .72, practically identical with the correlation between Information I-II and Otis S. A.

Summary. On the assumption that our measures of Information may be regarded as being sufficiently broad and general to give a statistically sound sampling of these pupils' general information, the following conclusions are valid:

1. General information is slightly less closely related to what the Stanford-Binet test measures than is Arithmetic Level or Completion Level.
2. General Information is slightly less closely related to what the Otis S. A. Test measures than is Arithmetic Level and slightly more closely related to it than is Completion Level.
3. General Information correlates with the Terman Group test in almost the same degree as it does with the Otis test.

It appears, therefore, that Information and Power (Level) are about equal in the extent to which they are related to these intelligence test scores.

IV. THE CORRELATION BETWEEN "GENERAL RANGE" AND INTELLIGENCE

Meaning of "General Range." In the preceding section we have determined the relation between Information as measured by the I. E. R. Information Test and Intelligence as measured by three intelligence tests. It now seems desirable to secure a more comprehensive measure of general information. The ability to solve the arithmetical problems on the lower levels and to complete the sentences in the lower levels may justly be regarded as information. It is somewhat difficult to distinguish between responses that we would classify as *information* and responses that we classify as *power*. In general, any response that comes readily, one that has been directly associated or connected with the stimulus that produces it, is regarded as information. If, however, the response is obtained by a recombination of ideas or associations, if it is the result of *reasoning*, if it is one that has not been specifically connected to the stimulus that produces it, then we may regard it as *power*. With this distinction in mind, it seems desirable to enlarge the information scores by including the scores on the lower (easier) levels of the I. E. R. Arithmetic tests and the I. E. R. Completion Tests.

Accordingly, a more general Range score was obtained, as follows:

$$\text{General Range} \begin{cases} \text{Series I} = \text{Information I} + \text{Arith. I} + \text{Completion I.} \\ \text{Series II} = \text{Information II} + \text{Arith. II} + \text{Completion II} \end{cases}$$

In building up this general range score the following elements were considered for inclusion.

Arithmetic Range I = Number right in Tests $A1 + C1 + AA$.

Arithmetic Range II = Number right in Tests $B1 + C2 + AAA$.

Completion Range I = Odds in Completion Test $A1$ and $B1$.

Completion Range II = Evens in Completion Test $A1$ and $B1$.

Information I = Test A + Test $C1$ + Test $D2$ + Test $F1$.

Information II = Test B + Test $D1$ + Test $E1$ + Test $E2$.

Would these Arithmetical and Completion elements in the General Range Score convert it into a combined measure of Information and Level? We have defined a pupil's "level" score to be that group of elements on which he does 50% of the elements correctly. If any considerable number of pupils failed

to secure a level score as high or higher than the level in which the elements selected for inclusion in the General Range score occur, then obviously we would be combining both measures of range and measures of level.

To secure some information about the difficulty of these elements, an analysis of the original data was made to find out the difficulty of each test element. Table 22 shows the percentage of incorrect responses to each element.

TABLE 22.
Percentage of Incorrect Responses (Arithmetic)

<i>Element</i>	<i>Test A1</i> %	<i>Test B1</i> %	<i>Test C1</i> %	<i>Test C2</i> %
1	11.7	8.4	36.1	26.1
2	4.5	6.2	23.9	15.5
3	18.4	19.5	26.1	8.9
4	14.5	3.9	25.0	35.5
5	2.8	16.2	13.9	27.2
6	22.3	5.0	30.6	21.4
7	10.6	12.3	45.5	27.2
8	3.4	16.7	33.9	27.2
9	6.2	18.4	34.4	28.9
10	2.3	23.4	27.2	30.0

Tests AAA and AA are not included here. These were very easy tests on which the average accuracy was approximately 80 per cent. Hence they need not be considered in the analysis of the arithmetical elements to determine whether measures of level have combined with measures of information.

A study of the difficulty of these test elements shows that 15 of these 40 elements were missed by more than 25% of the pupils. It would appear, therefore, that these test elements were of such difficulty as to differentiate the pupils according to Arithmetic Level.

It seems desirable to reduce the difficulty of the arithmetical elements that are to be included in the General Range Score. We are, therefore, limiting the measure of arithmetic range as follows:

Ar. Range, Series I: Number of correct responses to Tests *AA* and *A1*.
Ar. Range, Series II: Number of correct responses to Tests *AAA* and *B1*.

A similar study of the difficulty for our group of the Completion Test elements that were considered for inclusion in the general range serves (see Table 23) to show that seven of the 22

elements were missed by more than 25% of the pupils. As in the case of the arithmetic problems, this degree of difficulty is sufficient to produce considerable differentiation among the pupils.

TABLE 23.
Percentage of Incorrect Responses (Completion Test)

Test <i>AI</i>											
Element	1	2	3	4	5	6	7	8	9	10	
% Incorrect	12.7	8.9	5.0	7.8	23.3	4.4	27.8	35.0	17.2	2.2	
Test <i>BI</i>											
Element	1	2	3	4	5	6	7	8	9	10	11 12
% Incorrect	16.1	30.0	14.4	4.4	20.0	10.5	16.7	8.3	23.3	36.6	43.9 31.6

We considered it desirable to reduce the difficulty of this proposed Completion Range. This was accomplished by substituting Test *AA* for Test *BI*. The completion elements that were finally included in the final general range score were:

- Co. Range, Series I: Odds in *AA* and *AI*.
- Co. Range, Series II: Evens in *AA* and *AI*.

Composition of General Range Score. Our General Range Score is constructed as follows:

- General Range, Series I { I. E. R. Information Tests A1, C1, D1, and F1.
I. E. R. Arithmetic Test AA and A1.
I. E. R. Completion Test AA and A1 (odds).
- General Range, Series II { I. E. R. Information Tests B1, D1, E1 and E2.
I. E. R. Arithmetic Problems Tests AAA and B1.
I. E. R. Completion Tests AA and A1 (evens).

Reliability of General Range Scores. The reliability correlation coefficient between Series I and Series II is .74; corrected, $r = .85$.

Weighting the Arithmetic, Completion and Information Tests that are combined to form the General Range Score. The Completion Test is much more inclusive than either of the others; it inventories pupil's information about many fields of knowledge. Obviously it should be weighted higher than either of the other tests. It was decided to weight the Arithmetic and the Comple-

tion elements approximately equally, allowing the two combined as much influence as the information elements. The standard deviations of these tests are:

$$\begin{aligned}\sigma \text{ Information} &= 4.9 \\ \sigma \text{ co. Test} &= .81 \\ \sigma \text{ ar. Test} &= 2.01\end{aligned}$$

To secure the desired weighting it is fairly accurate to multiply the Completion Test Scores by 3. We are now ready to determine the correlation between General Range and Intelligence.

Correlation between General Range and Stanford-Binet. The coefficient of correlation between the General Range and the Stanford-Binet Mental Age is (see Correlation Table 24) .74;

TABLE 24
General Range

		60 61	62 63	64 65	66 67	68 69	70 71	72 73	74 75	76 77	78 79	80 81	82 83	84 85	86 87	88 89	90 91	92 93	94 95
Stanford-Binet	280-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
	270-9	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
	260-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
	250-9	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	--
	240-9	--	--	--	--	--	--	1	--	--	--	1	--	--	4	1	1	1	1
	230-9	--	--	--	--	--	--	--	--	--	3	--	2	1	--	--	1	--	--
	220-9	--	--	--	--	--	--	--	--	--	1	2	1	3	2	2	--	1	--
	210-9	--	--	--	--	--	--	--	1	3	3	3	7	1	3	3	--	1	--
	200-9	--	1	--	--	1	3	1	7	5	--	4	2	2	2	2	--	--	--
	190-9	--	--	--	--	1	--	3	2	2	5	5	8	--	5	--	--	--	--
	180-9	--	1	--	1	4	1	3	2	3	5	1	1	2	--	--	--	--	--
	170-9	--	--	2	--	2	3	1	6	3	1	--	--	--	1	1	--	--	--
	160-9	2	1	2	--	1	1	3	2	1	1	--	1	--	1	--	--	--	--
	150-9	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--

corrected for attenuation, $r = .80$. When the scores were combined without adjusting their relative weights, r was .69. In this case it should be noted that arithmetic scores contributed nearly three times as much weight as completion scores, while Information Scores contributed about eight times as much.

We recall that the correlation between Information and Binet was .62. The enlargement of the range score to include arithmetical information and that type of information involved in completing easy sentences has increased the correlation to .80. Our method of building up the General Range Score gives a great deal of confidence in believing that we have not combined range of information and measures of level.

Range correlates considerably higher with Stanford-Binet than does either Arithmetic Level or Completion Level. Whether Range correlates higher with Binet than would Arithmetic Level and Completion Level *combined* may be determined by computing the multiple correlation coefficient, R . If we compute R 1.23 in which 1 represents Stanford-Binet, 2 represents Arithmetic Level and 3 represents Completion Level, we find that the correlation between Stanford-Binet and Arithmetic Level combined with Completion Level is .74 ($R = .74$). Even yet Range correlates higher with Binet than does Arithmetic Level combined with Completion Level.

Correlation between General Range and Terman Group. The raw coefficient of correlation between General Range and Terman Group Test is .73; the corrected coefficient is .80 (see Correlation Table 25).

TABLE 25
General Range

	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94
	61	63	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	95
Completion Speed																		
220-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
210-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
200-9	--	--	--	--	--	--	--	--	--	1	--	2	3	1	2	2	--	--
190-9	--	--	--	--	--	--	1	--	--	--	--	3	--	2	2	1	1	--
180-9	--	--	--	--	--	--	--	--	1	1	1	6	5	4	--	1	--	--
170-9	--	--	--	--	--	--	1	1	1	1	6	4	3	2	1	--	--	--
160-9	--	--	--	--	--	2	--	2	1	4	2	4	3	1	--	--	--	--
150-9	--	--	--	--	--	--	--	2	4	1	2	1	--	1	--	--	--	--
140-9	--	--	--	--	1	2	2	4	2	4	3	1	2	2	--	--	--	--
130-9	--	1	--	--	--	1	3	2	--	2	3	3	--	1	--	--	--	--
120-9	--	--	--	--	1	2	--	1	4	2	3	--	--	--	--	--	--	--
110-9	--	--	--	--	--	4	2	--	2	2	2	--	--	--	--	--	--	--
100-9	--	--	--	--	--	1	--	1	3	3	--	--	--	--	--	--	--	--
90-9	1	1	3	--	--	2	1	--	1	--	--	--	--	--	--	--	--	--
80-9	--	--	--	--	1	1	1	--	--	--	--	--	--	--	--	--	--	--
70-9	--	--	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
60-9	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Note that the Terman Group and the Stanford-Binet are equally closely correlated with our measures of General Range. The correlation between Terman and General Range is also equal to the correlation between Terman and Arithmetic Level; it is considerably higher than the correlation between Terman and Completion Level.

R between Terman and Arithmetic Level combined with Completion is .84. Thus, Arithmetic Level and Completion combined correlate with Terman slightly higher than does General Range. The reverse of this was true in case of Stanford-Binet.

Correlation between General Range and Otis S. A. From Correlation Table 26 we find that the correlation between General Range and the Otis S. A. Test is .68; corrected for attenuation,

TABLE 26
General Group

	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94
	61	63	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	95
<i>Otis</i>																		
69-72	--	--	--	--	--	--	--	--	--	1	--	1	1	1	2	1	--	1
65-68	--	--	--	--	--	--	--	--	--	1	1	5	2	2	--	1	--	--
61-64	--	--	--	--	--	--	1	1	--	--	2	1	2	2	2	1	1	--
57-60	--	--	--	--	--	--	1	2	2	--	2	4	4	4	2	--	--	--
53-56	--	--	--	--	--	1	1	--	2	5	3	5	4	1	--	1	--	--
49-52	--	--	--	--	2	2	1	2	2	2	6	3	1	2	--	--	--	--
45-48	--	--	--	--	1	1	2	6	1	6	2	3	1	1	--	--	--	--
41-44	--	1	--	--	1	2	1	7	5	2	1	1	1	--	--	--	--	--
37-40	1	--	3	1	2	2	2	2	--	1	--	1	--	1	--	--	--	--
33-36	--	1	1	--	3	1	2	--	5	1	--	--	--	--	--	--	--	--
29-32	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
25-28	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
21-24	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

$r = .74$. The correlation between Otis and Arithmetic Level is .83; between Otis and Completion Level, the correlation is .61. Continuing the analysis that was made with Binet and Terman, by combining Arithmetic Level and Completion Level, $R_{\text{Otis ar. Level co level}} = .85$. As with Terman, so with Otis S. A., the correlations with Range are lower than the correlations with Arithmetic Level and Completion Level combined.

THE RELATIONSHIP BETWEEN COMBINED SCORES ON THE THREE INTELLIGENCE TESTS AND COMBINED SCORES ON LEVEL

A composite measure of the intelligence of each pupil was made by combining the scores on each of the three intelligence tests. In obtaining the score the tests were weighted approximately equally. Similarly, a combined Level score was obtained for each pupil. The coefficient of correlation between Binet + Otis + Terman and Arithmetic Level + Completion Level is .72 (corrected, .86).

Similarly, the correlation between Binet + Otis + Terman and Arithmetic Range + Completion Range is .64 (corrected, .81), and the correlation between Binet + Otis + Terman and Arithmetic Speed + Completion Speed is .56 (corrected, .67). This shows that Level (Arithmetic and Completion combined) correlates highest with a composite of the three intelligence tests ($r = .86$); Range, when limited to Arithmetic and Completion combined (Information excluded) correlated with the Composite intelligence scores .81; and that Speed has the lowest correlation with the composite of the three intelligence scores .67.

THE RELATIONSHIP BETWEEN THE INTELLIGENCE TEST SCORES, ARITHMETIC LEVEL, ARITHMETIC RANGE AND ARITHMETIC SPEED

The following relations between scores on the Stanford-Binet test, arithmetic level, arithmetic range and arithmetic speed were arrived at by the method of partial correlation.

(1) The correlation between Binet and arithmetic level, with arithmetic range and arithmetic speed kept constant is .37 ($r_{12 \cdot 34} = .37$).

(2) The correlation between the Otis S. A. and arithmetic level, with arithmetic range and arithmetic speed kept constant, is .48 ($r_{12 \cdot 34} = .48$).

(3) The correlation between the Terman Group and arithmetic level with arithmetic range and arithmetic speed kept constant, is .02 ($r_{12 \cdot 34} = .02$).

With arithmetic range and arithmetic speed "partialled" out, arithmetic level correlated highest with the Otis S. A.; the correlation between arithmetic level and the Terman group test is practically negligible.

(4) The correlation between Binet and arithmetic range, with arithmetic level and arithmetic speed kept constant, is .12 ($r_{12.34} = .12$).

(5) The correlation between Otis S. A. and arithmetic range, with arithmetic level and arithmetic speed held constant, is .05 ($r_{12.34} = .05$).

(6) The correlation between Terman Group and arithmetic range, with arithmetic level and arithmetic speed kept constant, is .40 ($r_{12.34} = .40$).

Of the three intelligence tests, the Terman Group is influenced most by Arithmetic Range.

(7) The correlation between Binet and arithmetic speed with arithmetic level and arithmetic range kept constant is, = .27 ($r_{12.34} = .27$).

(8) The correlation between Otis S. A. and arithmetic speed, with arithmetic level and arithmetic range rendered constant, is .23 ($r_{12.34} = .23$).

(9) The correlation between Terman Group and arithmetic speed, with arithmetic level and arithmetic range held constant, is .25.

THE RELATIONSHIP BETWEEN INTELLIGENCE TEST SCORES, COMPLETION LEVEL, COMPLETION RANGE AND COMPLETION SPEED. By the method of partial correlation, the following relationships are found to exist:

1. The correlation between Binet and Completion Level, with Completion Range and Completion Speed rendered constant, is .53 ($r_{12.34} = .53$).

2. The correlation between Otis S. A. and Completion Level, with completion Range and Completion Speed held constant is .13 ($r_{12.34} = .13$).

3. The correlation between Terman Group and Completion Level, with completion Range and Completion Speed rendered constant, is .26 ($r_{12.34} = .26$).

Completion Level, when freed from the influence of Completion Range and Completion Speed, is more closely associated with the Terman than with either of the other tests.

4. The correlation between Binet and Completion Range, with Completion Level and Completion Speed rendered constant, is .20 ($r_{12.34} = .20$).

5. The correlation between Otis S. A. and Completion Range, with Completion Level and Completion Speed rendered constant, is .39 ($r_{12.34} = .39$).

6. The correlation between Terman Group and Completion Range, with Completion Level and Completion Speed rendered constant, is .38 ($r_{12.34} = .38$).

The two group tests, Otis and Terman, are about equally influenced by Completion Range; they correlate higher with Completion Range than with Completion Level.

7. The correlation between Binet and Completion Speed, with Completion Level and Completion Range constant, is .31 ($r_{12.34} = .31$).

8. The correlation between Otis S. A. and Completion Speed, with Completion Level and Completion Range constant, is .29 ($r_{12.34} = .29$).

9. The correlation between Terman Group and Completion Speed, with Completion Level and Completion Range constant, is .02 ($r_{12.34} = .02$).

Summary of Analyses by Partial Correlation. Summarizing the results of the two preceding sections, we note the following:

$r_{\text{Binet Ar Level} \cdot \text{Ar Range Ar Speed}}$	= .37
$r_{\text{Otis Ar Level} \cdot \text{Ar Range Ar Speed}}$	= .48
$r_{\text{Terman Ar Level} \cdot \text{Ar Range Ar Speed}}$	= .02
$r_{\text{Binet Co Level} \cdot \text{Co Range Co Speed}}$	= .53
$r_{\text{Otis Co Level} \cdot \text{Co Range Co Speed}}$	= .13
$r_{\text{Terman Co Level} \cdot \text{Co Range Co Speed}}$	= .26
Mean	<hr/> = .30

$r_{\text{Binet Ar Range} \cdot \text{Ar Level Ar Speed}}$	= .12
$r_{\text{Otis Ar Range} \cdot \text{Ar Level Ar Speed}}$	= .05
$r_{\text{Terman Ar Range} \cdot \text{Ar Level Ar Speed}}$	= .40
$r_{\text{Binet Co Range} \cdot \text{Co Level Co Speed}}$	= .20
$r_{\text{Otis Co Range} \cdot \text{Co Level Co Speed}}$	= .13
$r_{\text{Terman Co Range} \cdot \text{Co Level Co Speed}}$	= .38
Mean	<hr/> = .26

$r_{\text{Binet Ar Speed} \cdot \text{Ar Level Ar Range}}$	= — .27
$r_{\text{Otis Ar Speed} \cdot \text{Ar Level Ar Range}}$	= .23
$r_{\text{Terman Ar Speed} \cdot \text{Ar Level Ar Range}}$	= .25
$r_{\text{Binet Co Speed} \cdot \text{Co Level Co Range}}$	= .31
$r_{\text{Otis Co Speed} \cdot \text{Co Level Co Range}}$	= .29
$r_{\text{Terman Co Speed} \cdot \text{Co Level Co Range}}$	= .02
Mean	<hr/> = .23

Thus, the mean of the partial correlation coefficients between intelligence test scores and Level, when freed from Speed and Range (arithmetic and completion range, not what we earlier called general range) is slightly higher than the mean of similar coefficients between intelligence test scores and either range or speed.

GENERALIZED RELATIONSHIPS BETWEEN LEVEL, RANGE, SPEED AND INTELLIGENCE

We have dealt with only two of an infinite number of possible measures of level, namely, level in solving arithmetical problems and level in completing sentences. Obviously we could secure measures of level with respect to many other functions. Having used only these two measures of level and the three measures of intelligence, can we determine the *true* relationships between them? With the data at hand we can only *estimate* this relationship. The following formula for estimating this relationship from our data was suggested to the writer by Professor E. L. Thorndike.

$$\begin{aligned} r_{\text{general level and Binet}} &= \sqrt{\frac{(r_{\text{ar. level and Binet}}) (r_{\text{co. level and Binet}})}{(r_{\text{ar. level and co. level}}) (r_{\text{Binet and Binet}})}} \\ &= \sqrt{\frac{.65 \times .65}{(.55) (.90^*)}} = .93 \end{aligned}$$

$$\begin{aligned} \text{imilar.} \\ r_{\text{general level and Otis}} &= \sqrt{\frac{(r_{\text{ar. level and Otis}}) (r_{\text{co. level and Otis}})}{(r_{\text{ar. level and co. level}}) (r_{\text{Otis and Otis}})}} \\ &= \sqrt{\frac{.83 \times .61}{(.55) (.90^*)}} = .98 \end{aligned}$$

$$\begin{aligned} \text{and} \\ r_{\text{gen level and Terman}} &= \sqrt{\frac{(r_{\text{ar. level and Terman}}) (r_{\text{co. level and Terman}})}{(.55) (.90)}} \\ &= \sqrt{\frac{.80 \times .66}{(.55) (.90^*)}} = \text{Approx. } 1. \end{aligned}$$

On basis of these assumptions the correlation between "general level" and intelligence is .97 (mean of the three coefficients).

A similar analysis of the relation between "generalized range" scores and intelligence test scores, limiting range to arithmetic and completion range, shows:

*Estimated.

$$r_{\text{general range and Binet}} = \sqrt{\frac{r_{\text{co. range and Binet}} \times r_{\text{ar range and Binet}}}{(r_{\text{ar. range and co. range}}) (r_{\text{Binet and Binet}})}} \\ = \sqrt{\frac{.46 \times .46}{(.43) (.90^*)}} = .73$$

$$r_{\text{general range and Otis}} = \sqrt{\frac{.67 \times .68}{(.43) (.90^*)}} = \text{Approx. 1.}$$

$$r_{\text{general range and Terman}} = \sqrt{\frac{.78 \times .70}{(.43) (.90^*)}} = +8.$$

The mean of these correlations, .91, shows that "general range," as defined here, is slightly less closely related with intelligence test scores than is "general level."

In the same way, the relationship between "general speed" scores and intelligence test scores, is found to be:

$$r_{\text{general speed and Binet}} = \sqrt{\frac{.55 \times .49}{(.50) (.90^*)}} = .59$$

$$r_{\text{general speed and Otis}} = \sqrt{\frac{.71 \times .49}{(.50) (.90^*)}} = .77$$

$$r_{\text{general speed and Terman}} = \sqrt{\frac{.67 \times .32}{(.50) (.90^*)}} = .49$$

The mean of these correlations is .62.

This analysis shows that "speed in general" is decidedly less closely associated with intelligence test scores than is "level in general" or "range in general."

It should be noted that in this section Range has been limited to Arithmetic Range and Completion Range. If with these measures of Range we had combined the measures obtained from the I. E. R. Information Test, the relationship between "generalized" range scores and intelligence scores would have been higher. It is important to remember that "level in general" correlated more closely with "intelligence in general" than does either of the other qualities.

Summary. This investigation has determined the degree to which speed, power, and range of information are respectively related to what is measured by the Stanford-Binet, the Otis Self Administering and the Terman Group Intelligence Tests. It has attempted to analyze these complex instruments by determining their relationships with more clearly defined and more restricted abilities.

Expressed in tabular form the correlations are as shown in the table below.

	Stanford-Binet	Otis S. A.	Terman Group	Arithmetic Speed	Completion Speed	Arithmetic Level	Completion Level	Information	General Range
Stanford-Binet -----	*	74	77	55	49	65	65	62	80
Otis S. A. -----	77	*	88	71	49	83	61	71	74
Terman Group -----	77	88	*	67	32	80	66	74	80
Arithmetic Speed -----	55	71	67	79	50	76	--	--	--
Completion Speed -----	49	49	32	50	88	--	--	--	--
Arithmetic Level -----	65	83	80	76	--	87	55	64	--
Completion Level -----	65	61	66	55	40	55	82	64	--
Information -----	62	71	74	--	--	64	64	--	--
General Range -----	80	74	80	--	--	--	--	--	--

These correlations justify the following conclusions:

(1) Speed, as we have measured it, has the lowest correlations with the Intelligence Test scores, the mean of the six correlations being .54.

(2) Information (as measured by the I. E. R. Information Tests) correlates considerably higher with scores on the Intelligence Tests than does Speed. The mean of the three correlations is .69.

(3) Level is next in the degree to which it correlates with intelligence test scores; the mean of the six correlations is .70.

(4) General Range correlates most highly with the intelligence test scores, the mean of the three correlations being .77.

IMPLICATIONS OF THE INVESTIGATION

This investigation shows that scores made by 180 pupils on these three tests are about equally closely related to the factors that we have called Level and Range. While correlation should

*In correcting for attenuation, the reliabilities of these tests were assumed to be 1.

not be associated with causation, it is probably valid to conclude that Range and Level are approximately equal determiners of the scores that pupils make on these tests.

We are tempted at this point to indulge in a speculation concerning the causes or factors that contribute to Range and Level. The writer is of the opinion that one's score on Level is contributed to more by innate, natural capacity than by education. It would seem rather futile to attempt to teach a pupil to make a higher score on Level, particularly on completion Level. As one matures or grows, he will be able to score higher on Level, probably without much regard to the content of his education. In the case of Range, it seems that one's score, while apparently a simple function of education, is in reality dependent upon what we call intelligence, as well as upon education. One's Range is determined by one's receptiveness to, and assimilation of, experience as well as by one's variety or breadth of experience. Consequently Range is obviously a function of intelligence as well as education.

APPENDIX I

THE RELATION BETWEEN SPEED AND ACCURACY

The writer was interested in comparing the speed at which pupils respond correctly on test elements to the speed at which they respond incorrectly to test elements of about the same difficulty for pupils in general. Some excellent teachers urge their pupils "to take plenty of time" lest they make mistakes;—they argue that pupils' errors are due to haste, to the carelessness attending rapid work; other teachers of excellent repute urge that pupils to work rapidly, arguing that rapidity increases concentration, which in turn increases accuracy.

To secure some evidence on this problem, the 20 test elements in I. E. R. Arithmetic Tests C1 and C2 were studied. The median number of seconds spent on the examples that were done correctly was compared with the median number of seconds spent on those that were done incorrectly. The results appear in Table 27.

TABLE 27

Test Element	No. Correct Solutions	Median No. Seconds Required	No. Incorrect Solutions	Median No. Seconds Required
C11	115	15	65	15
C12	119	22	61	23
C13	133	19	47	20
C14	135	31	45	84
C15	155	13	25	24
C16	125	26	55	49
C17	98	45	82	55
C18	119	20	61	30
C19	118	65	62	56
C110	131	24	49	44
C21	133	18	47	14
C22	154	14	26	20
C23	152	12	28	14.5
C24	164	16	16	18
C25	116	28	64	39.5
C26	131	35	49	30
C27	142	14	38	42½
C28	131	13	49	19
C29	128	25	52	41
C210	126	30	54	33½

Median time for correct solutions, 21 sec.; median time for incorrect solutions, 30 sec.

A study of the table shows that the median time spent on the incorrect solutions was greater on 16 out of the 20 test elements; on three of the examples the median time spent on the correct solutions was greater than the time spent on the incorrect solutions; on one example the medians were equal.

Within the range of difficulty represented by these tests, those problems that are solved correctly require appreciably less time than those that are solved incorrectly. The writer suspects, however, that this fact would not hold with more difficult problems. Observation of pupils' study suggests that they tend to "size up" a more difficult problem and frequently decide rather quickly that it is beyond their power to solve. Consequently, if *omissions* be included among *incorrects*, the reverse relation might obtain.

A similar analysis of the relation between the time spent on the correct responses to the I. E. R. Completion Test B1 and C1 and the time spent on the incorrect response (see Table 28) bears out even more positively the conclusion drawn from the study of the arithmetic problems.

TABLE 28

Test Element	No. Correct Responses	Median Time Required	No. Incorrect Responses	Median Time Required
B11	151	12	29	18
B12	126	8	54	18
B13	154	11	26	12
B15	144	10	36	20
B16	161	13	19	15
B17	150	12	30	13
B18	165	13	15	14
B19	138	11	42	19
B110	114	10	66	13
B111	101	13	79	18
B112	121	12	57	23
B21	159	4	21	7
B22	149	11	31	18
B23	144	6	36	23
B25	150	10	30	14
B26	127	14	53	15
B27	91	11	89	23
B28	140	16	40	15
B29	112	12	68	12

NOTE: Test elements B14, B24 and B210 are omitted because of the small number of incorrect responses, 8 on B14, 13 on B24, and 9 on B210. The medians on these are too unstable to make them trustworthy.

Here we find the median time spent on the correct responses lower than the median time spent on the incorrect elements in 17 out of 19 instances.

APPENDIX II

The correlation between a Composite of the I. E. R. Information and Level Tests and the Three Intelligence Tests.

The Problem. The content of an intelligence test usually involves items of information, arithmetical problems, analogies, selection of best answers, word meanings, and classifications. The I. E. R. Tests used in this study were limited to items of information, arithmetical problems, and completion sentences. The problem of this section is: Will a combination of these tests correlate as high with standard group intelligence tests (Terman Group or Otis S. A.) as they correlate with each other?

Procedure. A composite score was derived for each pupil. This composite score was the sum of the scores on the I. E. R. Information Tests, the I. E. R. Problems Tests A1, B1, C1, and C2, and the I. E. R. Completion Tests A1, B1, and B2.

The coefficient of correlation between the Composite Scores* and Otis S. A. Scores (see Correlation Table 29) is .87; corrected for attenuation $r = .98$.

TABLE 29
General Range

	0 2	3 5	6 8	9 11	12 14	15 17	18 20	21 23	24 26	27 29	30 32	33 35	36 38	39 41
<i>Otis S. A.</i>														
69-72	--	--	--	--	--	--	--	--	2	--	2	3	--	1
65-68	--	--	--	--	--	--	--	1	3	4	4	--	--	--
61-64	--	--	--	--	--	--	--	1	1	5	3	2	1	--
57-60	--	--	--	--	1	2	3	3	4	4	4	4	--	--
53-56	--	--	--	--	4	2	4	4	5	3	--	--	--	--
49-52	--	--	--	1	2	1	6	7	4	1	--	--	--	--
45-48	--	--	1	1	4	4	5	5	5	--	--	--	--	--
41-44	--	--	4	2	2	12	1	--	1	--	--	--	--	--
37-40	3	--	1	4	5	1	--	2	--	--	--	--	--	--
33-36	--	1	3	3	--	2	4	--	--	--	--	--	--	--
29-32	1	--	1	--	1	--	--	--	--	--	--	--	--	--
25-28	--	--	1	--	--	--	--	--	--	--	--	--	--	--
21-24	2	--	--	--	--	--	--	--	--	--	--	--	--	--

We have almost reproduced the Otis S. A. Test! The Composite test correlates practically as high with Otis S. A. as Terman group correlates with it (.88).

Correlation between Composite and Terman Group Test. The most interesting of all the correlations appears when the Composite is correlated with Terman Group. See Correlation Table 30.

TABLE 30
Composite

	0 2	3 5	6 8	9 11	12 14	15 17	18 20	21 23	24 26	27 29	30 32	33 35	36 38
<i>Terman Group</i>													
200-9	--	--	--	--	--	--	--	--	--	1	1	--	1
190-9	--	--	--	--	--	--	--	2	1	5	2	1	--
180-9	--	--	--	--	--	--	--	2	5	2	1	--	--
170-9	--	--	--	--	--	--	--	3	8	6	1	--	--
160-9	--	--	--	--	2	2	5	4	3	2	2	--	--
150-9	--	--	--	--	--	--	7	7	4	1	--	--	--
140-9	--	--	--	--	--	2	3	5	--	--	1	--	--
130-9	--	--	1	1	6	5	4	--	5	--	1	--	--
120-9	--	--	3	--	3	3	1	4	2	--	--	--	--
110-9	--	--	1	3	--	7	2	--	--	--	--	--	--
100-9	--	--	2	4	3	2	--	--	--	--	--	--	--
90-9	--	--	--	--	2	3	3	--	--	--	--	--	--
80-9	3	1	3	1	1	--	--	--	--	--	--	--	--
70-9	--	--	--	1	1	1	--	--	--	--	--	--	--
60-9	3	--	--	--	--	--	--	--	--	--	--	--	--

*The reliability coefficient of the Composite is .80; corrected, .89.

Here the coefficient of correlation is .94; the corrected value of r is .991. An almost perfect reproduction. The composite correlates appreciably higher with Terman than do the Otis and the Terman: — .94 as against .88.

The correlation between the Composite and the Stanford-Binet. The Pearson r between Composite and Stanford-Binet for our 180 cases (see Correlation Table 31) is .78; corrected for attenuation, $r = .83$.

TABLE 31

Composite

	0	3	6	9	12	15	18	21	24	27	30	33
	2	5	8	11	14	17	20	23	26	29	32	35
<i>Binet Mental Age</i>												
280-9	--	--	--	--	--	--	--	--	--	--	1	--
270-9	--	--	--	--	--	--	--	1	--	--	--	--
260-9	--	--	--	--	--	--	--	--	--	--	--	1
250-9	--	--	--	--	--	--	--	--	--	2	--	--
240-9	--	--	--	--	--	--	--	2	3	2	--	1
230-9	--	--	--	--	--	--	2	1	3	2	--	--
220-9	--	--	--	--	--	--	2	3	5	1	1	--
210-9	--	--	--	--	1	2	4	3	6	5	2	--
200-9	--	--	1	--	6	4	5	6	3	2	1	--
190-9	--	--	1	1	4	4	5	7	6	1	1	--
180-9	--	1	1	6	--	8	4	3	--	2	--	--
170-9	2	--	6	1	5	4	1	--	1	--	--	--
160-9	3	--	1	3	3	2	2	1	1	--	--	--
150-9	--	--	--	--	--	--	--	--	--	--	--	--
140-9	1	--	1	--	--	--	--	--	--	--	--	--

The Composite Test obviously does not measure every thing that is measured by the Stanford-Binet. It does, however, correlate with Stanford-Binet higher than do either of the two standard instruments, Terman and Otis.

Conclusion. The combination of test elements based upon information, arithmetical problems, and completion sentences, makes a test that correlates as closely with the Terman Group, the Otis S. A. and the Standard-Binet, as they correlate with each other.

VITA

John Roscoe Clark was born at Bloomfield, Indiana, August 18, 1887. He attended the rural schools of Green County, Indiana, and the Bloomfield high school; received the degree of Bachelor of Arts from Indiana University in 1912, majoring in Mathematics; was a graduate student in University of Chicago 1914-1918; and entered Teachers College in September, 1920.

He taught in the rural schools of Indiana, in the high schools of Owensburg, Switz City, Kokomo, Rushville, Fort Wayne, Oak Park (Illinois) and Chicago (Illinois); instructed in the teaching of mathematics in the Chicago Normal College, in the University College of the University of Chicago, in Hampton Institute and in Teachers College.

He is now Editor of the Mathematics Teacher, a member of the staff of the Lincoln School, and Associate (elect) in Mathematics in Teachers College.

